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WATER SUPPLY AND WASTE DISPOSAL PROBLEMS  
AT REMOTE AIR FORCE SITES IN ALASKA

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## ABSTRACT

A review of some of the water supply and waste disposal problems at remote Air Force sites is presented. Some of these problems directly affect health and well being. Others concern unaesthetic conditions and lack of convenience, and although less critical, they still influence man's ability to function effectively in cold environments.

Specific problems and their solutions are discussed and illustrated. Examples include: (1) Color removal -- the color removal facility at the Middleton Island water supply and its application to the other sites; (2) Iron removal -- progress in the design of a compact and simple iron removal facility for use at remote sites; (3) Disposal of waste in areas where water is not readily available -- the aerobic recirculating waste treatment system for conservation of water and disposal of wastes; and (4) Oil carriage-sewage incineration method of waste disposal used at Pt. Barrow.

Problems which remain to be solved are evaluated.

Investigation conducted under Cross Service Agreement (CSA 61-1) by Arctic Health Research Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Anchorage, Alaska.

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## **WATER SUPPLY AND WASTE DISPOSAL PROBLEMS AT REMOTE AIR FORCE SITES IN ALASKA\***

### **BACKGROUND**

The U. S. Air Force stations at remote sites in Alaska include Eielson AFB near Fairbanks and Elmendorf AFB. The problems exhibited at any one station are not necessarily unique to that station, and the information obtained in attempting to solve a problem at one station could reasonably be expected to apply to similar problems at other stations in Alaska, and perhaps at stations other than those in Alaska. Factors, including climate and geology, which seem to oppose the establishment of a familiar mode of living are so many and, in general, far removed from the conditions of life to which most men are accustomed that many environmental problems do arise.

Prominent among these problems are those relating to sanitation. Included are situations or conditions which represent a hazard to the health of personnel or to the health of individuals. Less serious, but more numerous, are problems of an aesthetic nature or those involving comfort. It is important to emphasize that seemingly insignificant problems, such as complaints that the water discolors laundry, are related in relation to all the environmental conditions under which the personnel live. For instance, at most stations there are no outdoor recreation facilities other than occasional attempts at fishing and hunting. Most recreation is restricted by lack of space to pool, ping pong and movies. If a town or village happens to be near by, there is not much in the way of recreation to attract the personnel. Also, even in the best location, life is not particularly enjoyable for more than a relatively short period. Under these circumstances any attempt to solve small problems and complaints is met with enthusiasm and appreciation. Fortunately, hazards related to sanitation have been eliminated by adequate facilities.

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\* Presented at the Eleventh Alaskan Science Conference, Alaskan American Association for the Advancement of Science, August 1964, at Anchorage, Alaska.

## **WATER SUPPLY AND WASTE DISPOSAL PROBLEMS AT REMOTE AIR FORCE SITES IN ALASKA\***

### **BACKGROUND**

The U. S. Air Force stations at remote sites in Alaska include all installations except Eielson AFB near Fairbanks and Elmendorf AFB at Anchorage. The problems exhibited at any one station are not necessarily unique to that station, and the information obtained in attempting to solve a given problem could reasonably be expected to apply to similar problems at other AF stations in Alaska, and perhaps at stations other than those in Alaska. The factors, including climate and geology, which seem to oppose man's attempt to establish a familiar mode of living are so many and, in general, are so far removed from the conditions of life to which most men are accustomed, that many environmental problems do arise.

Prominent among these problems are those relating to sanitation. Included are situations or conditions which represent a hazard to the general health of personnel or to the health of individuals. Less serious, but more numerous, are problems of an aesthetic nature or those involving convenience and comfort. It is important to emphasize that seemingly insignificant problems, such as complaints that the water discolors laundry, must be evaluated in relation to all the environmental conditions under which the men live. For instance, at most stations there are no outdoor recreational activities other than occasional attempts at fishing and hunting. Most indoor activities are restricted by lack of space to pool, ping pong and movies. Even if a town or village happens to be near by, there is not much in the way of diversion to attract the personnel. Also, even in the best location the weather is not particularly enjoyable for more than a relatively short period. Under these circumstances any attempt to solve small problems and minor complaints is met with enthusiasm and appreciation. Fortunately, major health hazards related to sanitation have been eliminated by adequate initial design of facilities.

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\* Presented at the Eleventh Alaskan Science Conference, Alaska Division, American Association for the Advancement of Science, August 30, 1960, at Anchorage, Alaska.

## WATER SUPPLY PROBLEMS

In general, the water supply problems are more often aesthetic than real. At most of the stations bacteriological examination of the raw and treated water seldom show the presence of coliform bacteria. Since there is no practical test for the presence of helminth parasites in the water, the possibility of health hazard from this source must be considered. The color, present in most of the water supplies, is due in the case of ground water to iron and manganese, or in the case of surface supplies, to the presence of dissolved or colloidal organic materials which have been leached from the tundra or from other vegetation.

Lack of water creates a number of problems in some areas. Shortages are due primarily to insufficient storage capacity rather than an insufficient quantity of raw water. In some instances melted snow is the sole source of supply. Use of a bulldozer or a similar vehicle to collect the snow for melting introduces the possibility of contamination with soil and other foreign matter. In addition to causing turbidity, the soil particles offer protection for microorganisms and may also be responsible for introducing parasites which have been deposited in the snow by animals in the area.

The Air Force station at Middleton Island has the most elaborate and complete water treatment plant of all remote stations in Alaska. The water contains varying amounts of fecal pollution from the enormous sea gull population in the area of the raw water reservoir, and varying amounts of color due to leaching of organics from the ground vegetation. The treatment plant consists of prechlorination, flocculation, sedimentation, pressure sand filters, pressure carbon filters, and postchlorination.

Raw water color is reduced from a range of 40 to 120 units to a treated water color range of 10 to 40 units. Although no data are available to show how much color is removed by each of the processes, the carbon filter is presumed to be the primary factor. This unit is loaded at the rate of  $2.8 \text{ gpm/ft}^2$  or  $1.08 \text{ gpm/ft}^3$ , about the same loading as is applied to the sand filters.

At the Kotzebue site, water is obtained from a creek which collects the melting snow in the spring. A 2,000,000-gallon tank is filled shortly after breakup each year and the stored water is used until the following spring. The water is high in color, ranging from 40 to 70 units, and has a high chlorine demand. Initial chlorination is supplied at the pump house, and the water is again chlorinated when it is withdrawn from the storage tank for

if chlorination were instituted, it should be possible to use the snow melter for both types of supply. Elimination of rust appears to be a simple matter of reconditioning the snow melter so as to cover all rusted surfaces and of providing a filter if the problem of turbidity continues. Present efforts to provide separate drinking water supply are pointless and dangerous, since the final supply is usually contaminated and generally too warm to be palatable.

## WASTE DISPOSAL PROBLEMS

Most of the main camps at remote sites have conventional plumbing facilities and water-carried waste disposal systems. Frequently a few men in an isolated weather reporting station or some other functional unit separated from the main camp may have to tolerate more primitive devices, such as bucket toilets, for waste disposal systems. Septic tanks, frequently heated, are used to provide effective, year-round waste treatment at most sites. Typical of occasional localized problems is the Unalakleet system where the drain from the septic tank extends only a short distance from the camp. Both unsightly and odorous situations are created, particularly during the summer. A heated effluent line extended further from the camp appears to be the solution to this problem.

At the Tin City site a separate tank and conventional pumping system are provided at the hilltop radar dome. However, an acute water shortage exists since all the water must be carried to the top camp by an aerial tram line. Water for toilet flushing is severely rationed. In an attempt to alleviate this type of problem, electric incinerating toilets have been tried with but little success. The heating elements have failed repeatedly and the odor problem has not been completely eliminated.

As an alternative the Air Force installed a number of recirculating type waste disposal systems, incorporating a two-compartment treatment tank to provide aeration and subsequent sedimentation before reuse of the liquid. Since many of these units did not function properly, the Arctic Health Research Center was asked to evaluate the system and to suggest operational procedures which would make them more effective. Experimental units, designed to test type of air supply, baffling modifications, etc., were installed at Tatalina and Sparrevohn sites and at the Federal Prison Camp at Elmendorf AFB. Because of its proximity to the AHRC Laboratory, the latter unit has been studied intensively and has provided the most valid data. Samples have been analyzed chemically for pH, solids, chlorides,

temperature and chemical oxygen demand (COD). Laboratory tests are now underway to determine the cause of the continuing odor complaints and to develop means of combating them. A high color in the recirculating water also has been noted. At present it is felt that with proper attention these units will perform adequately for approximately six months without flushing and refilling the storage tank with fresh water. If feasible, this will save 99 percent of the water used for waste disposal.

Body wastes are deposited directly into 55-gallon drums in the latrine buildings at the Point Barrow camp. Filled drums are hauled by tractor trailer to a dump about a mile away. Again, because of the physical layout of the camp and the lack of running water, it has not been possible to install a water-carried waste disposal system.

Under a contract with the Arctic Aeromedical Laboratory, Northwestern University has developed an oil carriage-sewage incineration system for disposal of human waste at Point Barrow. The toilets are flushed with fuel oil, supplied under pressure by a pump when the user throws a switch to open a solenoid valve. Adequate flushing has been obtained with as little as two quarts of oil, although the average use was greater during the trial run recently completed. The fuel pump switch also actuates a household garbage grinder installed directly under the toilet. The waste slurry flows by gravity to a storage tank where it remains until it is needed as fuel for the boiler. If the boiler is needed before a sufficient quantity of slurry has been accumulated, fresh fuel oil can be added. Before switching to waste slurry, the storage tank mixer is operated for 10 minutes to insure a homogeneous feed. The waste slurry is by-passed until the three-way valve is opened which simultaneously cuts off the fresh fuel. Sufficient waste slurry is pumped so that even when the boiler is operating at the maximum rate, some fuel is by-passed. The amount of water and waste in the slurry is well dispersed and low enough in quantity so that the boiler performance is not adversely affected.

During the first operational test, solids settled in the feed line during low fuel feed rates, and when fuel feed rate subsequently was increased to meet higher demands, the settled wastes entered the boiler in a slug and extinguished the flame. A reduced pipe diameter has overcome this difficulty.

In the test run just completed, the system operated for 20 hours on waste slurry and for 80 hours on fresh fuel before the diaphragm valves in the system failed and clogged the burner ports. Elimination of these minor mechanical failures should permit satisfactory operation of the oil carriage-sewage incineration method.

## SUMMARY

Most of the existing problems in Air Force remote site water supply and waste disposal involve inconvenience rather than health hazards. However, some potential hazards, such as the possible presence of viable parasitic eggs in the water supply, remain to be evaluated. Inability to maintain a chlorine residual in the drinking water is a health hazard which must be overcome, as is the presence of coliforms in turbid water which has an adequate chlorine residual. To boost morale and to improve aesthetic value, it would be desirable to remove iron and manganese from the potable supplies.

In circumstances where privies or bucket toilets are in use, continued efforts to develop electric incinerating toilets are warranted.

In all of these problems, the main objective is the provision of equipment which requires very little attention or maintenance and yet performs adequately under the environmental conditions found at remote installations.